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Question Paper Code : 20435

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2018.

Seventh Semester

Electrical and Electronics Engineering

EE 6004 — FLEXIBLE AC TRANSMISSION SYSTEMS

(Regulations 2013)

(Also common to PTEE 6004 — Flexible A/C Transmission System for B.E. (Part-Time) — Seventh Semester — Electrical and Electronics Engineering — Regulations 2014)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. State the need for FACTS devices in power transmission.

2. Differentiate compensated and uncompensated lines.

3. Compute the maximum power transfer if a unlimited variable shunt compensator is connected to the middle of the transmission line to maintain the midpoint voltage at 1 p.u. The end voltages are regulated at 1.01 p.u, reactance of transmission line as X = 0.4 p.u and $\delta = 25°$.

4. Name the different switching strategies adopted in switching the TCR module.

5. What are the limitations in TCSC operation?

6. Draw V-I and X-I characteristics of single module TCSC and Two modules TCSC.

7. Compare SSSC and TCSC.

8. Draw the schematic diagram of STATCOM.

9. Name the optimization tool used for controller coordination.

10. How could the adverse interactions of controllers be identified?

PART B — (5 × 13 = 65 marks)

11. (a) (i) Compare the synchronous condenser, phase shifting transformer and fixed series compensator. (6)

(ii) Compare the modern shunt compensator and series compensators in detail. (7)

Or

(b) Consider a 735 kV symmetrical lossless transmission line with l = 0.932 mH/km, C = 12.2 nF/km, and a line length of 900 km. Frequency 50 Hz. If a midpoint compensator is installed to regulate the midpoint voltage at 1.02 pu with a rating of – 400 MVAR to + 400 MVAR, calculate the loading limits for which the compensator would regulate the bus voltage at 1.02 p.u. (13)

12. (a) Deduce the VI characteristics of SVC with FC and TCR in detail. Draw the schematic and explain the basic operation of SVC. (13)

Or

(b) Consider a SMIB system in which the synchronous machine is generating 0.9 p.u. MW and 0.3 p.u. MVAR. The voltage of Infinite bus is 0.995 + j0.0 p.u. The machine transient reactance is 0.3 p.u. and the transmission line reactance is 0.650 p.u.

(i) Calculate what should be the net susceptance of SVC to maintain V_m at 1 p.u. (7)

(ii) Given B_σ = susceptance offered by transformer = 0.025 p.u on 100 MVA, 400 kV base, find B_{TCR} and B_{TSC}. Given rating of one capacitor bank is 50 MVA. (6)

13. (a) Explain the basic principle of TCSC. Explain different modes of TCSC operation. (13)

Or

(b) Consider the SMIB system in which the synchronous machine is generating 0.9 pu MW and 0.25 p.u. MVAR. The infinite bus voltage is 1 at angle of 0. The machine transient reactance is 0.35 p.u and the transmission line reactance is 0.65 p.u. Calculate the value of net reactance offered by the TCSC, the degree of series compensation and the voltage that has to be injected by the TCSC to enhance the power flow to 1.0 pu. (13)

14. (a) Explain the principle of operation of STATCOM. Prove that STATCOM enhances the steady state power transfer capability of a transmission line. (13)

Or

(b) Prove that SSSC enhances the steady state power transfer capability of a transmission line. Draw the P-δ characteristics of SSSC. (13)

15. (a) Explain SVS-SVC controller interactions. Illustrate the coordinated design SVC of controllers. (13)

Or

(b) Explain in detail genetic algorithm based tuning of controller gain parameters of SVCs. (13)

PART C — (1 × 15 = 15 marks)

16. (a) Prove that power transfer capability of power transmission system with STATCOM connected to midpoint is more when composed to uncompensated case. (15)

Or

(b) Consider a 735kV symmetrical lossless transmission line with $L = 0.932\,mH/km$, $C = 12.2\,nf/km$ and a line length of $800\,km$, Frequency = 50Hz. If a SVC is installed at the midpoint to regulate the midpoint voltage at 1.02 p.u. with a rating of –600 MVAR to +400 MVAR. Calculate the loading limits for which the SVC would regulate the bus voltage. (15)

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